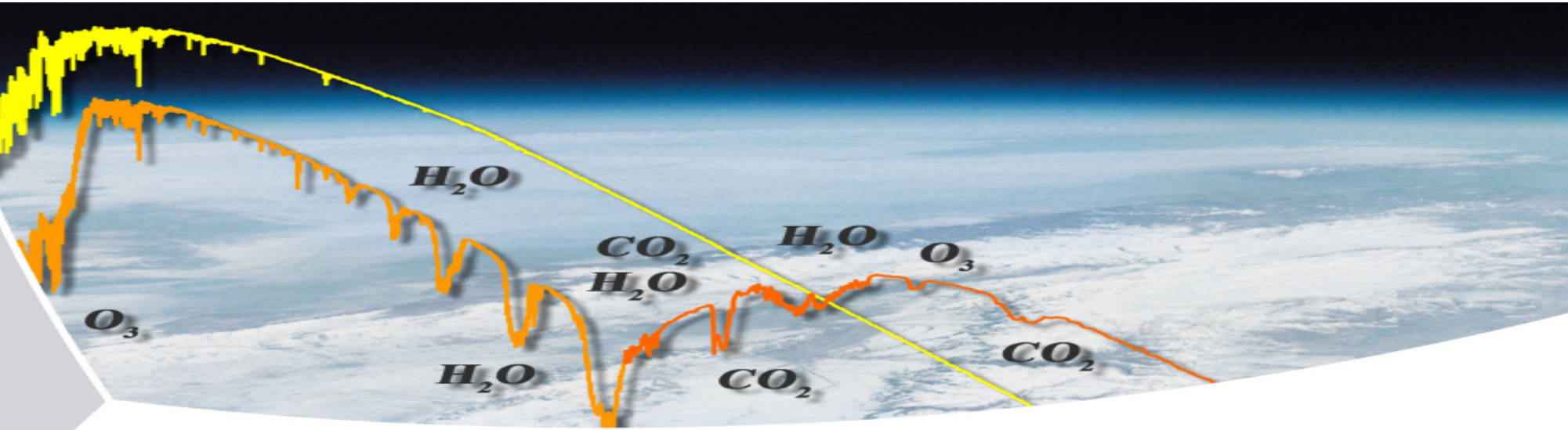

Impact of Molecular Absorption Spectroscopy Data on S5P Infrared Carbon Gas Concentration Retrievals — MADSICC

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Introduction — Motivation

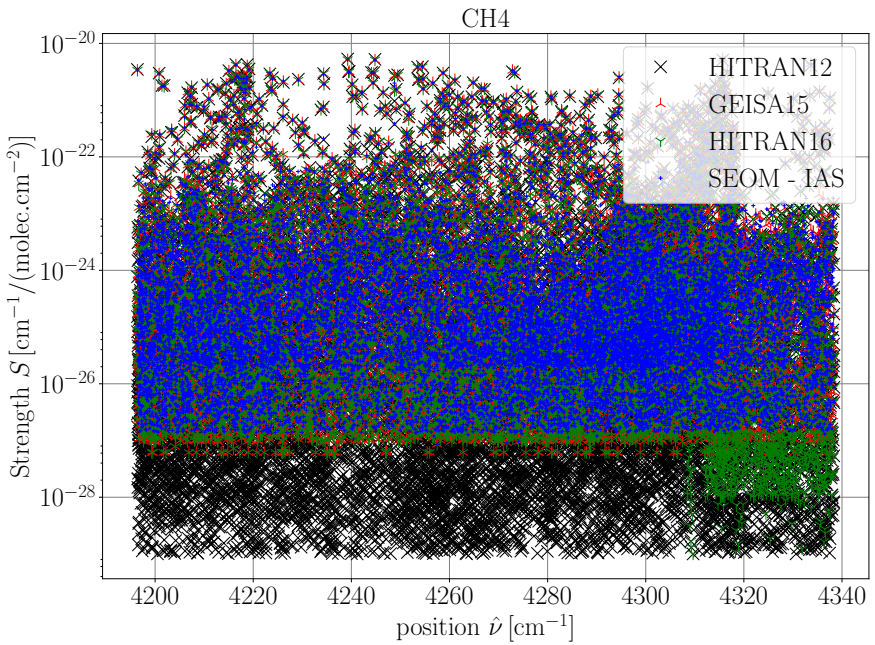
- SWIR spectra of S5P/Tropomi contain information on CO, CH_4, ...
- Various auxiliary data required for Level 1$\rightarrow$2 processing

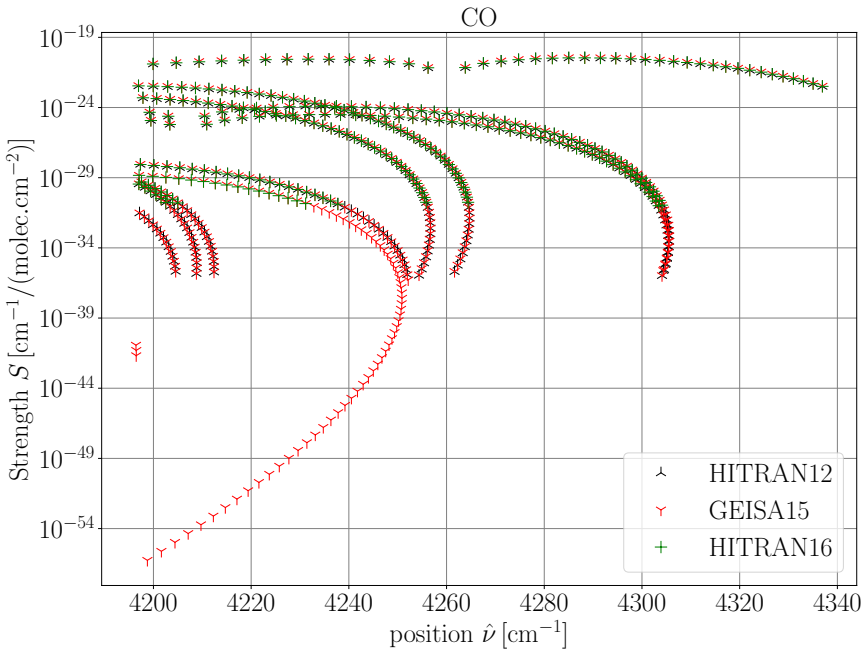
?¿? How do molecular spectroscopy line data impact retrievals **?¿?**

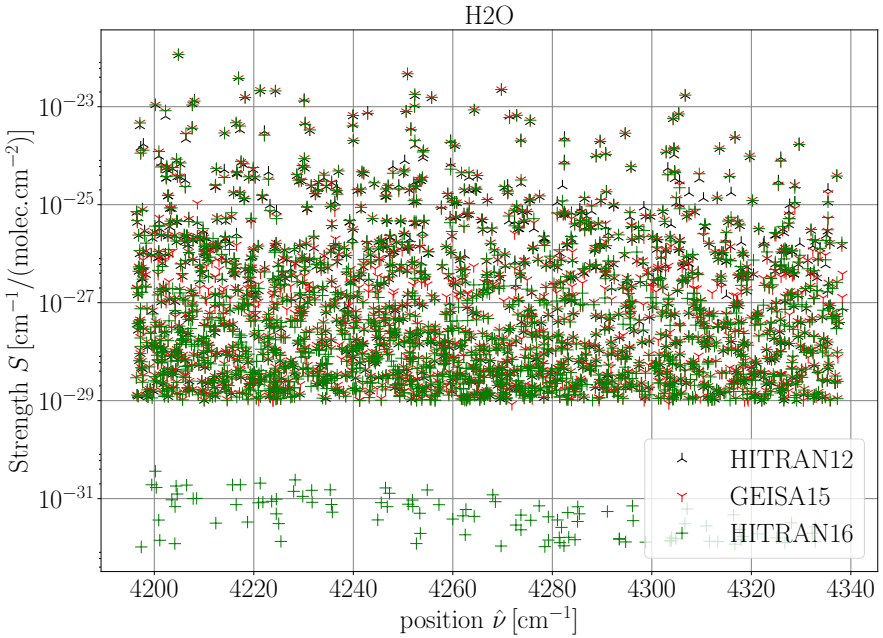
Molecular Spectroscopy Data

Lines in S5P-SWIR:

	CO	CH_4	H_2O
GEISA 2011:	518	13519	844
HITRAN 2012:	403	20578	1460
GEISA 2015:	518	14616	2921
HITRAN 2016:	310	15965	3169
SEOM–IAS :	–	18218	–







- Goals: Improve spectroscopic data in TROPOMI 2.3 μm region
- Labs and Instruments:
  - FTS measurements at DLR
    Bruker IFS 125HR, White-type multireflection cell
  - CRDS (Cavity RingDown Spec.) measurements at LIPhy
    DFB laser based spectrometer 4248 – 4257 cm^{-1}
- First results:

  CH_4: new line positions, intensities and additional line parameters in the range 4190–4340 cm^{-1}

  CO: recommendation to use Hitran12

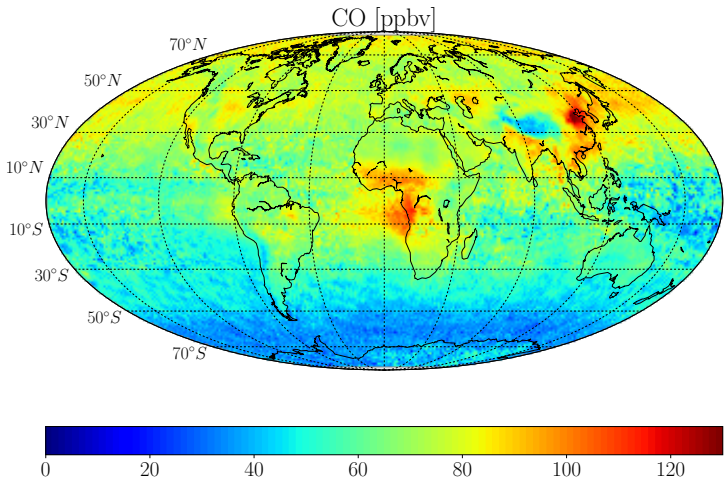
  H_2O: Satisfactory agreement of FTS and CRDS intensities, major intensity differences to Hitran, good agreement with ab initio

  All: Residuals indicate narrowing and line mixing
  $\longrightarrow$ speed dependent Voigt with line mixing

Tools: BIRRA and RemoTeC

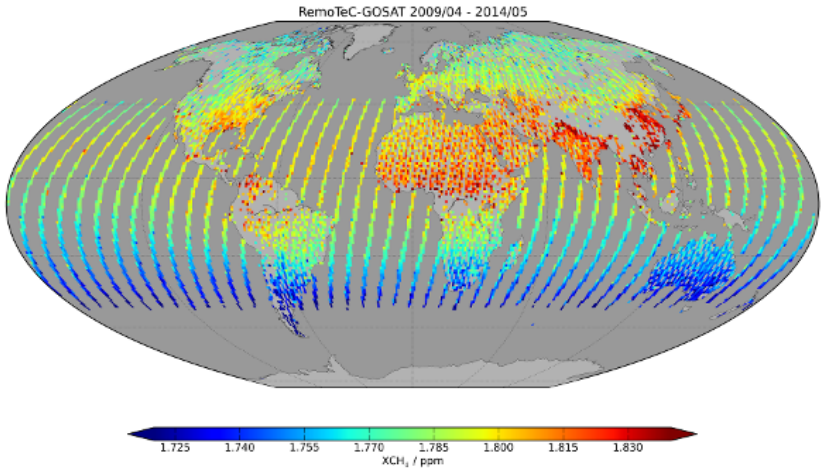
Beer InfraRed Retrieval Algorithm

- Separable least squares of molec. scale factors (and some aux. par.) to radiance
- Forward model: GARLIC
  Generic Atmospheric Radiation Lbl Infrared Code
- Originally developed for SCIA nadir CO, CH_4



RemoTeC

- "Full physics:" Retrieve gases *and* aerosols to account for light path modification
- Heritage: GOSAT (& OCO-2)
- Forward model: linearized vector rad. transfer
- Tikhonov regularization



Proposed Work

?¿? How do molecular spectroscopy line data impact retrievals ?¿?

- Update SEOM-IAS literature review

- Initial analysis performed on synthetic observations (see poster)
- Upgrade codes
  - BIRRA: S5P data ingestion, spectral response, refined line shape ...
  - RemoTeC: refined line shape

- S5P data processing: Comparison of total column retrievals using the SEOM-IAS database vs. Hitran, Geisa, ...
  - CO with BIRRA and CH_4 with RemoTeC
  - residual analysis
  - total columns and errors

→ Recommendations for further lab spectroscopy

References: see poster!